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DOWNY MILDEW OF TOBACCO

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INTRODUCTION

Downy mildew, or, as it is frequently called, blue mold, caused by the fungus *Peronospora hyoscyami* DBy., is a disease comparatively new to tobacco growers of this country. It has long been a problem, however, in Australia, where its destructive nature is only too well understood. In Australia, as early as 1891, this disease was said to be threatening the tobacco industry with extinction; and, as late as 1931, a responsible authority there again referred to it as the industry's most serious menace.

In the United States, the disease was first observed on cultivated tobacco in 1921, but neither in that year nor in 1931, when it was again seen, did it do any serious damage. Consequently, while its possibilities were recognized, prior to 1932 there was no way of knowing with certainty how serious a problem it might become in this country. However, this question has now been answered very definitely, for beginning in Georgia in January, 1932, and continuing until early summer, it was active over a constantly enlarging area that finally reached from Florida to Pennsylvania. The worst damage was done in North Carolina, South Carolina, and parts of Georgia, where plants were destroyed in enormous numbers. This disease was an important factor in a 350,000-acre decrease in the 1932 crop of flue-cured tobacco. In addition, much of the crop set in the affected areas was late, because of the shortage of plants, and the stands secured were poor and irregular in growth. Competent observers report that the mildew disease, as it developed in 1932, showed all the destructive characteristics that have long made it the Australian tobacco growers' most serious problem.

Since 1932 is the first year that the mildew has been important in the United States there are many questions about it yet to be answered. The first is what it may be expected to do in the immediate future. Judging from experience with this disease in other countries and from the history of similar diseases in this country, it is likely that the mildew problem is here to stay, and that destructive outbreaks will depend on the occurrence of weather conditions favorable for the disease. It is possible that the mildew may even extend to new districts as yet untouched, such as the Burley areas of Kentucky and Tennessee. It is to be regretted that the information available regarding this disease is very incomplete, and that, despite years of work, the Australians have not as yet developed satisfactory methods of control. Federal and State agencies are cooperating in research work designed to develop control measures, which is being pushed as rapidly as possible. This circular is intended to summarize the information now available.

DESCRIPTION OF THE DISEASE

Downy mildew is primarily a seed-bed disease, though occasionally it attacks plants in the field. The first indication of the disease in a bed is the appearance on a few leaves of indefinite yellow blotches. On the under surface of these spots is a cottony fungus growth (fig. 1) that is either white or pale violet in color. On the upper surface of the spots numerous brown flecklike lesions soon appear, and in a few days these enlarge and run together, forming irregular dead areas (fig. 2) that give the leaves the appearance of having been spattered with boiling water. At the same time that the attacked leaf tissues die and dry out, the fungus growth disappears from the lower surface of the spots. Later the dead leaf tissues drop out, and the leaves may become twisted as portions still alive continue to grow. There are many things which may cause spots on tobacco leaves, but finding the cottony growth on the lower leaf surface is an almost sure proof that the trouble is downy mildew. Final verification can only be had by observing the characteristic conidiophores and spores (fig. 3) under a microscope.

Small plants are likely to be killed outright by the first attack of the disease. Older plants may lose most of their leaves and still have strength to make new foliage if aided by a favorable change of weather. Transplanting from diseased beds before recovery has begun often results in the death of large numbers of the plants set. In the field, affected plants show dead brown spots of irregular shape, but this leaf injury usually is not serious. A more serious type of field injury has been the stunted uneven growth of plants in portions of fields set from diseased beds. This condition has been very common in some localities.

LIFE HISTORY OF THE MILDEW FUNGUS

The mildew fungus, *Peronospora hyoscyami*, viewed through a microscope, has definite structures, and the cottony growth of the under leaf surface is made up of mycelium, conidiophores, and spores. These correspond to the roots, trunks and branches, and fruit of a tree. The spores are very light and are produced on the tips of the conidiophores (fig. 3) in tremendous numbers. They are probably carried long distances by the wind. When a spore reaches a tobacco leaf, it germinates, and the mycelium grows into the leaf, killing the cells and producing a spot. About a week after germination and leaf penetration have occurred, the surface fungus growth

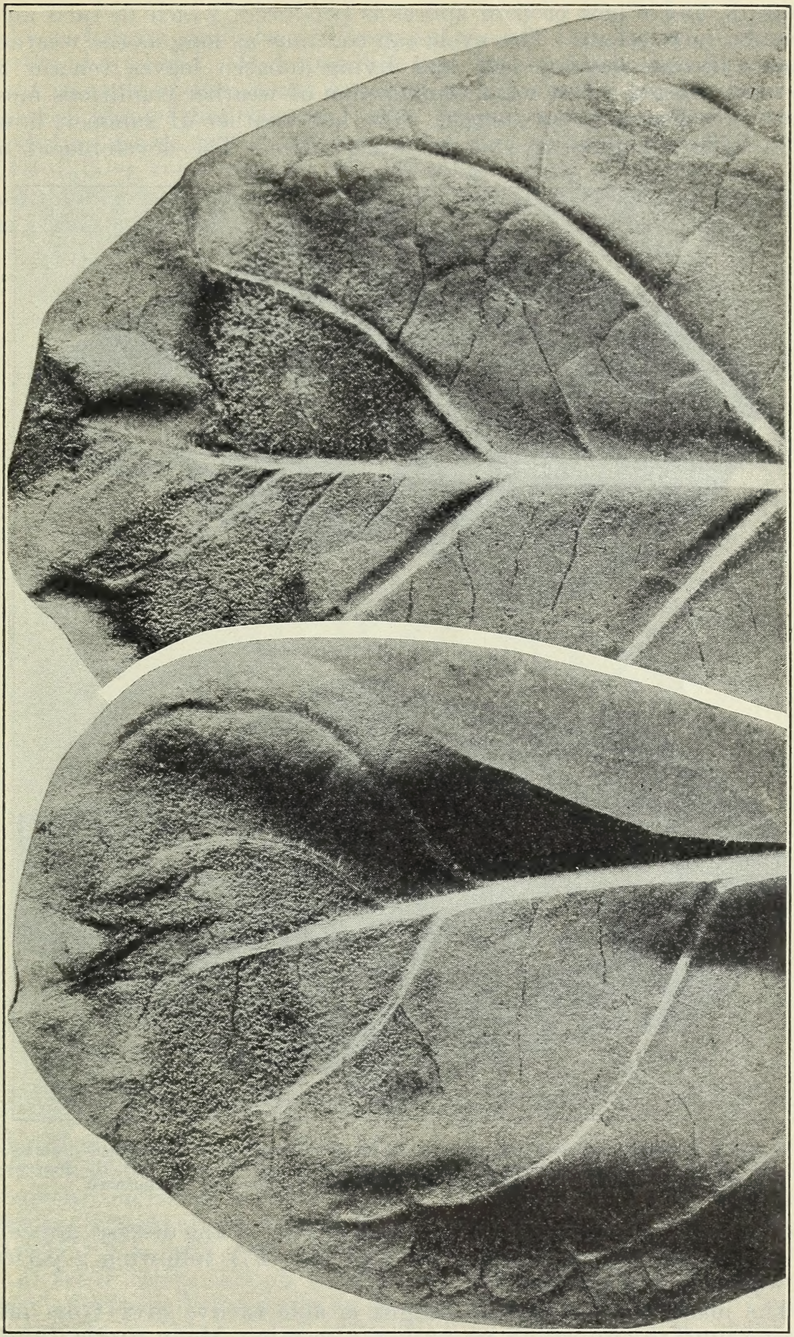

FIGURE 1.—Tobacco leaves showing the characteristic cottony growth of the downy mildew on the lower surface of the lesions

appears, and a new crop of spores is produced, which in turn may produce new lesions. This cycle can continue as long as the weather favors disease development and living tobacco leaves remain to become infected. Just what combination of weather conditions most favor the disease is not certain. The hot weather of summer, however, definitely puts an end to its activities. The development of spores, which are requisite to the rapid spread of the disease, appears to be favored by low temperature (40°–50° F.) following a period of warm, humid weather.

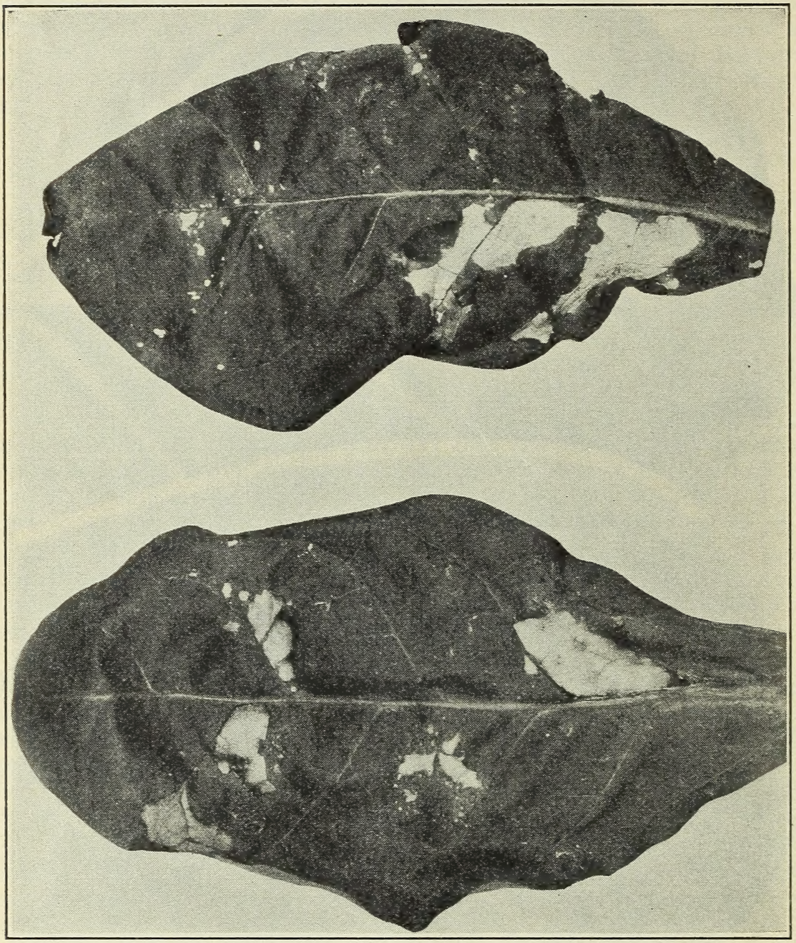

FIGURE 2.—Tobacco leaves five to seven days after the first appearance of the disease. The lesions are seen as numerous irregular dead areas scattered over the leaves. At this stage the fungus growth on the lower leaf surface has disappeared

The manner in which the fungus is able to live over from late spring until the following season is not certain. Many similar fungi produce heavy-walled resting spores (oöspores) which, like the seeds of higher plants, are able to remain alive a long time. These oöspores, however, are rarely if ever produced by the tobacco downy-mildew fungus, and the ordinary spores are thin-walled and relatively short-lived. It is possible that the mycelium remains dormant in some of the plants attacked and is carried over in the occasional plants that survive. The fungus, actively growing and producing spores, was actually observed during the winter of 1931–32 in Georgia on volunteer plants in old tobacco beds. Overwintering in this manner in the extreme South, it may possibly spread north as the season advances.

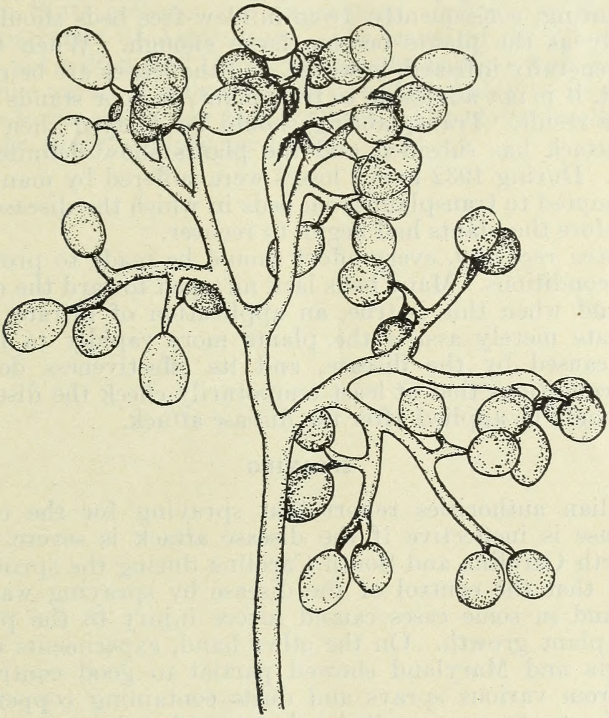

FIGURE 3.—A conidiophore bearing conidia. (× about 300.) The oval spores are very light and are easily carried through the air from leaf to leaf

CONTROL

NUMBER AND LOCATION OF BEDS

Until more certain methods of control can be developed than are now available, it will be advisable for growers in affected districts to sow an increased number of beds, as mildew, like most diseases, does not attack all plant beds with equal severity and some escape entirely. The beds should be separated and sown at different times. In districts warm enough for tobacco plants to survive the winter, every effort should be made to destroy all hold-over plants. There appears to be little use of attempting to find a place the mildew can not reach, since beds located in new woods clearings, remotely situated, seem as likely to be attacked as beds located in open fields.

The main point appears to be that out of a given number of beds some at least escape severe damage, and the more beds sown at different times the greater are the chances of successfully evading the disease. Beds located in warm areas generally make the most rapid recovery from mildew attack.

TRANSPLANTING IN RELATION TO DISEASE DEVELOPMENT

The plants are subject to mildew attack as long as they remain in the beds, but healthy plants usually are safe once they are set out. Transplanting, consequently, from mildew-free beds should proceed as rapidly as the plants become large enough. When beds have become generally infected, however, and the leaves are being rapidly destroyed, it is not advisable to transplant, as poor stands are likely to be the result. Transplanting should be delayed then until the disease attack has subsided and the plants show definite signs of recovery. During 1932 heavy losses were suffered by many growers who attempted to transplant from beds in which the disease was still active, before the plants had begun to recover.

To hasten recovery, every effort should be made to provide good growing conditions. Many beds lack nitrogen toward the end of the season, and when this is true, an application of nitrate will help. The nitrate merely assists the plants more rapidly to repair the damage caused by the disease, and its effectiveness depends on weather conditions that at least temporarily check the disease. The nitrate should be applied after the disease attack.

SPRAYING

Australian authorities report that spraying for the control of this disease is ineffective if the disease attack is severe. Reports from North Carolina and South Carolina during the spring of 1932 indicated that the control of the disease by spraying was unsatisfactory and in some cases caused severe injury to the plants and retarded plant growth. On the other hand, experiments conducted in Georgia and Maryland showed partial to good control of the disease from various sprays and dusts containing copper, and no injury of consequence resulted. A comprehensive program of research considering all aspects of the spray problem is in progress, but to reach definite conclusions will probably require at least several seasons of intensive effort. Meanwhile, the following program is suggested for those who desire to try spraying.

Bordeaux mixture appears to be about as effective as any other spray or dust, and either a 3–4½–50 or a 4–6–50 formula may be used. The first two figures of each formula refer to pounds of copper sulphate (bluestone) and hydrated lime, respectively, and the 50 refers to gallons of water. Applying the spray regularly every seven days and starting as soon as the plants are one-fourth inch across are suggested. These treatments may also assist in the control of certain other leaf-spot and plant-bed troubles. This program has the further advantage of insuring that the plants have some protection against mildew while they are small, for it is the very young plants that are most likely to be killed outright by the disease. Furthermore, young plants rarely suffer spray injury. Older plants are occasionally severely burned by the spray, but this injury is usually soon outgrown. Spraying should be stopped a week before transplanting, however, as there is evidence that plants heavily sprayed just before they are set out may not live as well as those not sprayed. It is never advisable to dip roots or tops of plants in Bordeaux mixture.

In spraying, care must be taken to insure that the mixture is properly and freshly prepared from suitable materials. Instructions on these points can be secured from the county agricultural agents, the State colleges and experiment stations, or the United States Department of Agriculture. The leaves of the plants should be dry but not wilted, and the spray must be applied with good pressure as a fine mist. For best results it will probably be necessary to cover both lower and upper leaf surfaces. The cloth should be kept off until the spray application is dry.

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